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August 19, 1996

John S. Morabito
Deputy Chief
Accounting and Audits Division
Common Carrier Bureau
Federal Communications Commission
1919 M. St., NW
Washington, D.C. 20554

RE: <u>Ex Parte Presentation</u>
CC Docket No. 96-45

Dear Mr. Morabito,

Pursuant to your letter of August 2, 1996, enclosed please find AT&T's and MCI's responses to the Federal-State Joint Board's request for information.

Certain limitations in available data prevent us from providing responses to question number one, portions of question 5, and question 6 at this time. We will provide responses to these questions during the week of August 18. We apologize for the delay in providing you with our answers.

Two copies of this Notice are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's rules.

Sincerely,

Michael Pelcovits /fha | Joel Lubin /fha

Michael Pelcovits
Chief Economist
MCI Telecommunications Corporation

Joel Lubin
Regulatory Vice President
AT&T Corp.

Attachment

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Response of
AT&T Corp. and MCI Telecommunications Corporation
to Questions Posed on the Hatfield Model by the
Federal Communications Commission and the Federal-State Joint Board Staff
in the Universal Service Proceeding (CC Docket No. 96-45)

August 16, 1996

Question 1

How do the actual reported loop costs (as computed by NECA) of incumbent local exchange carriers compare with the calculated proxy loop costs of the Hatfield model on a study area by study area basis and on a state by state basis? Show the number of lines in each density zone by state. Show results both on a total study area loop cost basis; total state loop cost basis; study area cost per loop basis; and state cost per loop basis. Show the actual annual USF dollars currently received (as reported by NECA) and the amount of support that would be received under the Hatfield model at the benchmark levels of $20, $30 and $40. Identify each study area by NECA study area code and indicate the state of operation. Data provided should be submitted on computer diskettes in a Excel format (version 4 or less) as well as on paper.

Responses to this question will be provided later.

Question 2

List and explain the differences between HM Version 2.2 Release 1 and Release 2.

The following discussions describe the changes made to the Hatfield Model Version 2.2 Release 1 (as released publicly May 30, 1996) that are now incorporated into Version 2.2 Release 2. For convenience, the Hatfield Model Version 2.2 Release 1 will be referred to as HM 2.2.1, and the Hatfield Model Version 2.2 Release 2 will be referred to as HM 2.2.2.

While there have been significant improvements to the modeling logic and descriptive outputs of the HM 2.2.2 over the HM 2.2.1, there are also two significant improvements from a user perspective. HM 2.2.1 used certain of the inputs and outputs of the December 1995 Benchmark Cost Model (BCM1) in its calculations. Because of infirmities in the BCM1 that limited the BCM1's speed, flexibility and effectiveness, HM 2.2.2 has chosen to incorporate a derivative work called the BCM Plus -- which has been developed for and copyrighted by MCI Telecommunications Corporation. HM 2.2.2 also now includes an automated user interface with dialog boxes that allow the user easily to change options and adjust inputs. The interface automates the running of the model as well.

The following describes the improvements to the modeling logic and descriptive outputs of the HM 2.2.2 over the HM 2.2.1.

BCM Plus Modules

Data module

- Input and output sheets include an additional column containing business line counts per census block group (CBG).

- In the presence of rocky terrain, feeder and distribution distances are increased by 20% to accommodate the routing of facilities around difficult placement conditions.

- Feeder length calculations are modified to place the Serving Area Interface (SAI) inside the CBG by a distance equal to one-fourth the length of a side of the CBG.

Loop module

- The distance at which fiber feeder is assumed is now user-adjustable. In the original BCM, the model assumed fiber feeder cables whenever total loop lengths were 12,000 ft or greater. In the HM 2.2.2, the calculation is based on total feeder length, and the threshold distance may be adjusted by the user to any value. The default setting is 9,000 ft.

- The circuit capacity per fiber is now adjustable, with a default value of 2016 DS-0s (equivalent to 3 DS-3s). In the original version, the model assumed a fixed 672 DS-0 per fiber capacity.

- The number of fibers required per digital loop carrier remote terminal is now adjustable. The default setting is four fibers, which is the same as the value fixed in the original BCM.

- Lookup tables for optical and copper feeder cable investment as well as distribution cable now allow user adjustment of cable sizes. The default maximum optical cable size is now 216 fibers. In the first BCM version, the maximum cross sections for optical and copper fiber and distribution cables were fixed. Also, fiber and copper cable investments per unit length have been adjusted to include engineering, delivery, and installation in addition to material investment. Neither BCM1 nor BCM2 appear to include installation, engineering, and delivery in this table. The default distribution cable investment table also now includes 25-pair cable.

- The module now computes varying numbers of distribution cables in a CBG according to density range to accommodate different population distributions.

- Density ranges are now expressed in terms of lines per square mile instead of the original households per square mile.

Hatfield Modules

Line Multiplier (now Line Converter) Module:

- The original Line Multiplier Module used user-specified line multipliers that varied by density range to estimate residential second lines, business lines, special access lines and public lines. The new Line Converter module applies a uniform multiplier across all CBGs to compute residence second lines. Business, special access, and public line calculations are based on data that estimate the number of business employees in each CBG. All line totals across types are computed to match those totals shown in the most recent ARMIS 43-08 reports.

- The input data now contains estimated 1995 household counts per CBG in place of the 1990 counts in the original BCM data.

- The module computes CBG density in terms of lines, instead of households, per square mile.

Wire Center Investment Module

- The module removes a previous double-counting of the cost of trunk ports by reducing the previously assumed per-line switching investment (which had already incorporated these costs) by $16 per line.

- STP size is now scaled by the number of A links required in the LATA/study area; the model previously equipped maximum-capacity Signal Transfer Points (STPs) in all cases.

- The module now computes the costs associated with SS7 C and D link investments in addition to A link investments -- whereas previously it calculated only SS7 A link investments.

- Transmission facilities investment per DS-0-mile, is now calculated separately and explicitly for each of the following types of interoffice transport routes:

- Common (tandem)
- Local direct
- IntraLATA toll direct
- IXC switched access direct
- Special access

- Calculations now allow separate user assumptions related to optical patch panels, optical multiplexers, regenerator investment and spacing, installation costs, mix of buried/underground/aerial plant, manhole and pole spacing, and installation.

- The module now eliminates double counting of structure costs that typically are shared between interoffice transport and loop feeder facilities.

- The model now reconciles annual usage calculations in the Expense Module with busy hour usage calculation in the Wire Center Investment Module.

- Operator services positions may now be located remotely from the operator tandem. The user may select the distance, with zero as the default value.

- The module now includes tandem-to-POP switched access direct transport facilities.

- End office switches are now also limited by number of traffic minutes switched. Previously, switches were assumed only to be limited by number of line and processor real-time limits. There are separate holding time multipliers for business and residence lines to allow users to compute the effects of increased holding time on costs.

- The module now uses pre-processed interoffice distance data derived from V&H information for end offices, tandems, and STPs contained in the Local Exchange Routing Guide (LERG). This facilitates the running of the model.

Convergence Module

- The module now computes separately structure costs for aerial, buried, and underground facilities, including poles, conduit, trenching, and manholes. The model treats underground and buried cable independently. The new version eliminates previous double counting of terminals and splices. All structure factors, including the mix of aerial, buried, and underground distribution and feeder facilities are user definable.

- Digital loop carrier (DLC) investment is now computed from the "ground up." The calculation includes site, housing, power, engineering, common equipment (including multiplexing at the wire center), and line cards.

- The new version corrects a calculation error in local direct and local tandem trunk investment

- Because the model specifies sufficient fiber feeder capacity to allow dedicated fibers for each DLC remote terminal, the model's default setting does not include the placement of optical multiplexers at SAIs. This is consistent with current practices.

Expense Module

- The module allows user-selectable service lives by plant category of up to 50 years (the previous maximum life was 32 years).

- Consistent with the new structure calculations and incorporation of separate underground and buried facilities inputs, the model now calculates separate expense factors for the following network components and facilities classifications:
  - Aerial cable
  - Underground cable
  - Buried cable
  - Poles
  - Manholes
  - Conduit

  (Previously only aerial and underground factors were calculated).

- Double counting of DLC trunk terminations and the end office line terminations that they subsume is eliminated.

- End office trunk port costs are now estimated on a per DS-0 or per minute basis.

- Default user inputs for cost of debt, equity, and debt/equity ratio have been changed.

- There are now separate uncollectibles rates for retail services and carrier-to-carrier services.

- The module eliminates a triple counting of NID investment.

- Drops are now computed per household rather than per line.

- Dedicated trunking calculations have been reconciled between the Expense Module and the Wire Center Investment Module.

- IXC switched access and local interconnection unit costs have now been developed and added to a new "cost detail" worksheet.

- NID expenses are now based on ARMIS-reported regulated expense per line (from the ARMIS "Other Terminal Equipment" account). Previously these expenses were calculated based on both regulated and unregulated expenses in the "Other Terminal Equipment" account, thus overstating greatly NID maintenance expenses.

- A carrier-to-carrier customer service expense has been added. This expense is user definable, with the default value set at $1.56/line/year -- which is inferred from ARMIS 43-04 data concerning the LECs' costs of serving their interexchange carrier customers' access needs.

- The new version includes a NID monthly cost calculation in the "cost detail" worksheet.

- Structure sharing fractions have been expanded to allow the user to set independently parameters for the sharing of aerial, buried, and underground distribution and feeder structure. The default value is 0.33 for each category.

- The module now contains a Universal Service Module with the following features:
  - Network cost built up from unbundled network elements (UNEs)
  - Network Operations expenses factored to reflect local service costs only
  - Local number portability costs have been added as a user input. The default setting is $0.25 per line per month.

<u>Question 3</u>

Explain any current Hatfield enhancements to the BCM1 regarding the cost of placing outside plant. Explain any plans for additional enhancements to the BCM1 regarding the cost of placing outside plant. Provide a date certain for when the planned enhancements will be provided to the Commission. Include an example that shows the *differences between the BCM1, the current Hatfield model and any planned enhancements to the cost of placing outside plant.*

The HM 2.2.2, as noted in the response to question 2, changes significantly the way in which outside plant investment is calculated. The new version computes investment explicitly for aerial, buried and underground cable, for both loop feeder and distribution facilities. The new version also permits separate assumptions and calculations for cost of trenching and conduit placement and the cable investments that these structure investments support. Similarly bifurcated are assumptions and calculations concerning manhole spacing and investment, and pole spacing and investment. There are separate structure inputs for distribution and feeder facilities as well as for interoffice facilities. The model also allows for sharing of interoffice and feeder structure -- as is the practice in existing LEC networks. In the presence of difficult placement conditions (primarily shallow bedrock and other rocky soil types), the model computes additional subfeeder and distribution cable lengths to accommodate routing around the rocky areas.

BCM1, in comparison, computes structure and its placement by multiplying the overall distribution and feeder cable investment by a "cable multiplier" --which is itself computed based on unviewable input assumptions concerning the degree of difficulty of structure placement under various soil types, bedrock depth, and water table conditions. The effect of this BCM1 multiplier was to understate structure investment under certain conditions, as well as to make structure investments variable depending on cable materials price discounts. Thus, a reduced price per foot for cable would correspondingly reduce BCM1's estimated structure investment. The HM 2.2.2 structure calculations bypass entirely these BCM1 calculations.

While the Hatfield Model will continue to evolve, there are presently no concrete plans concerning further changes to the cost of placing outside plant.

The following example compares the total loop cable and structure investment and the corresponding per-line values generated by the HM 2.2.2 and the BCM1 for the Norman, Oklahoma, wire center:

	Total Structure Cost	Total Cable Cost	Number of Lines	Structure Cost/Line	Cable Cost/Line
HM 2.2.2	$18,746,735	$10,881,855	50,966	$368	$214
BCM1	$1,951,958	$2,676,517	28,595	$68	$94

The BCM1 and HM 2.2.2 runs each used the same distribution and feeder cable fill factors. The BCM1 structure and cable values were extracted from the BCM1 loop module's "Costing" worksheet. The HM 2.2.2 results include all conduit, poles, manholes and trenches, and the cable investment cost includes installation.

Question 4

Compare any current or near term planned Hatfield enhancements to the BCM1 with the enhancements of the BCM1 included in BCM2.

Many of the enhancements of BCM1 that are included in BCM2 merely match BCM1 enhancements that were previously incorporated into HM 2.2.1, or are enhancements that are now being incorporated into HM 2.2.2. However, the Hatfield model also includes other features that make it a superior tool for cost estimation.

According to the submission filed in this proceeding by US West and Sprint on July 3, 1996, the specific enhancements to BCM1 included in BCM2, are as follows:

- BCM2 claims to use estimates of the number of business lines in each CBG (from an unidentified "public source") in sizing its loop plant. Version 2.2.1 of the Hatfield model also estimated the business lines in each CBG by using a density zone-specific factor multiplied against the number of households in that CBG. In version 2.2.2, the Hatfield model specifies business lines directly for each CBG using information contained in a November 1995 Dun and Bradstreet survey of the number of employees in each census tract.

  In BCM1, the costs of placing outside plant were calculated by applying a factor to the cost of cable. BCM2 enhances this calculation of placement costs by calculating structure costs separately from cable costs. Both HM 2.2.1 and HM 2.2.2 perform a similar bifurcated calculation, and in considerably more detail than BCM2. For example, Hatfield calculates buried and underground cable investments separately, while BCM2 continues to lump these two investments into a single unadjustable category. Indeed, BCM2 appears to neglect the cost of manholes completely.

- BCM2 now includes certain cost components (e.g., pedestal, drop wire and NID) that were not included in BCM1. Both HM 2.2.1 and HM 2.2.2 already included each of these item, and in a much more detailed fashion than BCM2. For example, BCM2 includes no investment in Serving Area Interfaces (SAIs), while both Hatfield releases do include such investments.

- BCM2 assumes that all digital loop carrier systems use non-integrated technology. Because integrated digital loop carrier (IDLC) systems are more efficient, the BCM2 assumption is not forward-looking. Hatfield assumes IDLC throughout. In addition, BCM2 models DLC investments in a very crude manner relative to the HM 2.2.2 method of building these investments from the ground up, and including the costs of siting the remote terminals, their power, and all relevant investments in electronics.

- BCM2 claims to incorporate an "enhanced switching module," although the enhancements are not documented and it appears that the switching module is very similar to that in BCM1, i.e., simply calculating a fixed cost and per-line cost for each switch. In contrast, the Hatfield model calculates switching investment by first considering the actual traffic originating and terminating in each wire center to size the switch, and then modeling the switch investment from the ground up, including land, buildings, power and all other relevant investments.

- BCM2 adds lines per household as an input variable. Both HM 2.2.1 and HM 2.2.2 already have lines per household as an input variable.

- BCM1 used a single factor, applied to total investment, to estimate expenses and capital-related recurring costs. BCM2 has been modified to use separate expense factors for each of three categories of plant, and applies some factors against lines rather than strictly against investments. Both HM 2.2.1 and HM 2.2.2 already develop expenses through multiple factors, but in a much more detailed way. Examples of this include: permitting the use of different depreciation schedules for different plant categories, applying expense factors on a plant category-specific basis, and calculating expense categories that vary with number of lines (e.g., billing, customer service, network operations) on a per-line basis. Hatfield also permits a much wider range of assumptions as to capital costs and operating expenses to be considered. The user may vary independently numerous input parameters in the Hatfield model, whereas to model identical assumptions as to capital costs and operating expenses in BCM2 would require the user to develop completely new factors that both reflect the desired input parameter values and that are consistent with the methodology used by the BCM2 developers.

- BCM2 claims to have modified the distribution architecture in densely-populated urban areas to better reflect the cost of plant placement in these areas. The Hatfield model already reflected the higher cost of plant placement in urban areas.

- BCM2 reduces the served land area in sparsely populated CBGs by assuming that all telephone subscribers are located within a maximum distance from the CBG's road network. This helps to overcome the overestimation of costs that occurred in BCM1 due to its assumption that population was distributed evenly across the CBG. A similar enhancement to reflect more accurately the costs in sparsely-populated areas is being developed for a future release of the Hatfield model.

- BCM2 caps investment in wireline loops to reflect its sponsors' belief that certain areas could more economically be served by wireless loop technologies. Currently, no similar cap on the investment in a loop is incorporated into the Hatfield model.

- BCM2 has been modified to extend feeder plant into each CBG, and places more distribution cables so that service is provided along each lot line. The Hatfield model Version 2.2.2 also extends feeder cable into each CBG, and varies the number of distribution cables by density zone.

- BCM2 makes the break point between use of copper versus fiber feeder a user variable. This variable was fixed at 12,000 feet in BCM1, BCM2 permits the user to choose between 9,000, 12,000, 15,000 and 18,000 feet. HM 2.2.2 also makes this break point a variable, but permits the user to select any break point desired.

- BCM2 accounts for the impact of terrain slope on outside plant costs in a manner not described in the filing. MCI, AT&T, and Hatfield are not convinced that this has a significant predictable impact on plant costs, hence the Hatfield Model does not account for slope at this time.

- BCM2 makes the depth at which water table involvement creates additional costs and the amount of such additional costs, user-adjustable variables. MCI, AT&T, and Hatfield are not convinced that this has a significant predictable impact on plant costs, and water table depth is not considered as a cost factor in the Hatfield model at this time.

The Hatfield model considers a number of factors that are not included in BCM2, and which make the Hatfield model a superior tool both for estimating universal service costs, and for estimating the costs of unbundled network elements.

- BCM2 does not attempt to model interoffice network costs. Instead, it simply applies a 3% factor against all other investments to estimate its amount of interoffice investment. Hatfield computes the actual investment in interoffice facilities required to provide service from the bottom up based on explicit calculations of the amounts of traffic flowing between individual wire centers.

- BCM2 does not attempt to model the costs of the SS7 signaling network. Hatfield estimates separately, and from the bottom up, the costs of signaling links, STPs, and SCPs.

- BCM2 is designed only to estimate the cost of basic universal service. The Hatfield model not only calculates this, but also calculates the cost of unbundled network elements. Because the Hatfield model first computes the cost of unbundled network elements, then builds the cost of basic universal service from these elements, Hatfield accounts for scale and scope economies, where they may exist. This reveals more accurately the true cost of universal service in a complete network. In contrast, BCM2 is more akin to a "stand alone" cost study for basic universal service.

- BCM2 relies exclusively on ARMIS data in calculating expenses. While Hatfield also relies on relationships developed from ARMIS data for some expense categories, incremental cost information is used whenever publicly available. In particular, BCM2 incorporates LECs' embedded customer operations and corporate operations expense on a per-line basis, thus BCM2 includes in its cost estimates all of the inefficiencies that currently exist in these functions.

Question 5
Provide the Hatfield study area results for Pacific Bell (PTCA), GTE SW - Arkansas (GTAR), and Southwestern Bell - Texas (SWTX). For each study area please provide:

The GTE holding company operates several study areas in Arkansas. Because GTE identifies different operating entities as reporting certain portions of its data in Arkansas than report other portions of its data, these GTE entities are combined in the following analyses. Thus, the GTAR identifier should be interpreted as mapping to all GTE-owned entities in Arkansas.

Question 5 Part A
Summary statistics: total investment; investment per line; loop investment per line; end office switching investment per line; monthly cost per line; loop monthly cost per line; end office switching monthly cost per line; total households; total residential lines; total business lines; total switched lines; the number of residential lines per density zone, and monthly cost per line per density zone.

See Attachment 5acdei - PTCA, SWTX, and GTAR.

Question 5 Part B

Model results reported on an ARMIS basis: all expenses and plant in service rows that are contained in ARMIS report 43-03. If any of these rows can not be shown separately, provide a list of rows that have been combined and the algorithm used to combine the rows.

See Attachment 5b - PTCA, GTAR, SWTX and COMBROWS.

Question 5 Part C

Switching: the total number of switches; the number of host, remote and stand alone switches; and the lines per each switch. Please explain how the cost of the switches was determined, provide all cost input data, and explain how the model determines whether a switch will be a host, remote or stand alone switch.

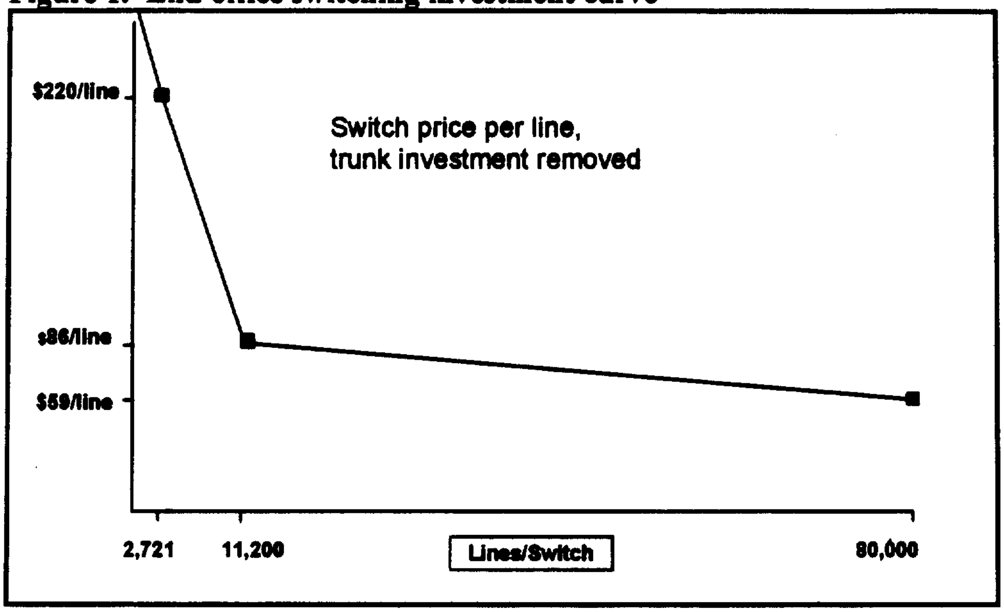
Numerical calculations provided in Attachment 5acdei - PTCA, SWTX, and GTAR.

The model assigns at least one end office switch to each wire center. It sizes switches in the wire center by adding up all the lines in the CBG's served by the wire center and then compares this line total to the maximum allowable switch size. This parameter is user-adjustable, but its default is set at 100,000 lines with a fill factor of 0.80, yielding a maximum effective switch size of 80,000 lines. The model will equip the wire center with a single switch if the number of switched access lines served by the wire center is no greater than 80,000, using the default assumptions. In general, a switch may serve any line count between zero and 80,000 (but in the HM is typically equipped with well less than 20,000 lines). Thus, if a wire center must serve 90,000 lines, the model will compute the investment required for two 45,000 line switches. The wire center module also compares the busy hour call attempts (BHCA) produced by the mix of business/residence lines served by each switch -- with a user-adjustable processor capacity (maximum of 600,000 BHCA) to determine whether the switch is line-limited or processor real-time-limited.

Once the model determines the end-office switch line size, it obtains the investment per line from an investment function that relates per-line switching investment to switch line size. The data to define this function were obtained from a publicly-available study of the central office equipment market published annually by McGraw-Hill. (Northern Business Information study: *U.S. Central Office Equipment Market -- 1995*, McGraw-Hill). This study shows the average investment per new line of digital switching paid by BOCs to be $102 and by Independents to be $235 in 1995. The model combined these figures with average BOC (11,200) and Independent (2,761) switch line sizes derived from data published in the FCC's Statistics of Communications Common Carriers (Federal

Communications Commission, *Statistics of Communications Common Carriers,* Tables 2.3 and 2.4, 1994 edition), along with information on much larger switches obtained from switch manufacturers to develop the complete investment function. The per-line investment figures include the entire end office switch, including trunk ports. Because the Wire Center Investment Module calculates trunk port investment separately from the switch common equipment and line circuit investment, each of the raw per-line investment figures is reduced by $16. This reduction results from an assumption of $100 per trunk port (per DS-0) and a conservative concentration ratio of six lines per trunk. The following figure shows the resulting investment curve.

Figure 1. End office switching investment curve



The switching investment input assumptions include aggregated pricing information for host and remote switches in addition to that for stand-alone end office machines. Thus, the model investment function automatically accommodates the type of switching entity (e.g., host, remote, or stand-alone) equipped in a given wire center.

Question 5 Part D

Cable and wire statistics: percent underground, buried and aerial; the length, gauge and size of copper cable used; length and size of fiber cable used; fill factors used as inputs; percent distribution fill determined by the number of lines served divided by the total number of distribution lines installed; percent feeder fill determined by the number of lines served divided by the total number of feeder lines installed (when the feeder is fiber, explain what assumptions were used to determine the capacity and use of the fiber); the distribution of households by loop length; and any factors that alter the cost of cable or *the installation of cable such as additional costs associated with placing cable in dense urban areas.*

Type of Cabling and Placement Structure

- Structure percentages are user-adjustable. The following tables show the model's default values:

Copper Distribution Cable Structure Type Default Values			
CBG Density (Lines/sq. mi.)	% Aerial	% Buried	% Under-ground
0 - 5	50%	50%	-
5 - 200	50%	50%	-
200 - 650	50%	50%	-
650 - 850	50%	50%	-
850 - 2550	45%	50%	5%
> 2550	65%	35%	5%

Copper Feeder Cable Structure Type Default Values			
CBG Density (Lines/sq mi)	% Aerial	% Buried	% Under-ground
0 - 5	50%	45%	5%
5 - 200	50%	45%	5%
200 - 650	50%	45%	5%
650 - 850	40%	40%	20%
850 - 2550	10%	10%	80%
> 2550	5%	5%	90%

Fiber Feeder Cable Structure Type Default Values			
CBG Density (Lines/sq mi)	% Aerial	% Buried	% Under-ground
0 - 5	35%	60%	5%
5 - 200	35%	60%	5%
200 - 650	35%	60%	5%
650 - 850	20%	60%	20%
850 - 2550	10%	10%	80%
> 2550	5%	5%	90%

- Copper cables of 2400 pairs and smaller are assumed to be 24 gauge copper. Cables of larger than 2400 pairs should be based on 26 gauge copper, since 24 gauge copper cables are not manufactured in sizes larger than 2400 pairs.
- All distribution cable is copper. Feeder is either copper or fiber/DLC depending on whether the feeder route exceeds 9000 feet. While the 9000 foot breakpoint between copper and fiber/DLC feeder is user-adjustable, users are cautioned against using breakpoints in excess of 12,000 feet as this may require special conditioning to accommodate digital services.
- When fiber/DLC feeder is used, four fibers are installed to serve the DLC remote terminal. Because there is one transmit fiber and one receive fiber, this provides 100% redundancy.

Fill Factors

- In the Hatfield model, cable fill is a function of two items: the maximum fill that the model allows to be engineered, and the extra spare that results from always installing a cable that has a number of pair that equals or exceeds the number of pair that the engineering specifications require. The following tables show the maximum engineered fill (which is user-adjustable). Attachment 5d demonstrates the actual effective fill in copper distribution cable when the extra pair in the cable beyond the engineering requirements are considered. As can be seen, this shows that the effective fill is substantially lower than the maximum engineered fill.

Copper Distribution Cable Default Maximum Engineered Fill Factor	
CBG Density (Lines/sq. mi.)	% Fill Factor
0 - 5	50%
5 - 200	55%
200 - 650	60%
650 - 850	65%
850 - 2,550	70%
> 2,550	75%

Copper Feeder Cable Default Maximum Engineered Fill Factor	
CBG Density (Lines/sq. mi.)	% Fill Factor
0 - 5	65%
5 - 200	75%
200 - 650	80%

Copper Feeder Cable Default Maximum Engineered Fill Factor	
CBG Density (Lines/sq. mi.)	% Fill Factor
650 - 850	80%
850 - 2,550	80%
> 2,550	80%

- Note that fill factors for fiber feeder are not terribly meaningful. The default assumption in the Hatfield model is that the four fibers feeding a DLC remote terminal (in all but the two lowest density zones) are equipped with electronics that can handle 2016 circuits (3 DS-3s). But, if demand on that feeder route expands beyond 2016 circuits, these four fiber feeder strands would not need to be augmented. Rather, higher capacity electronics would be added -- with the possibility to expand capacity in almost unlimited amounts. In the two lowest density zones, the four fibers are equipped to carry 96 circuits, but this figure, too, may be expanded through the installation of higher capacity electronics.
- For Digital Loop Carrier (DLC), since most of the investment is in line cards, fill factor refers to the utilization of line cards, not utilization of the maximum capacity of the remote terminal cabinet. The model assumes a small DLC system, referred to as AFC for the lowest two density zones. Normal DLC (which we shall term "SLC") is used for the four higher density zones. The user may input appropriate fill factors for AFC units, as well as for SLC. Default values are to equip both AFC and SLC with enough line cards so that the cards are only 90% utilized. As growth occurs, a technician may be dispatched at biannual or annual intervals to augment the number of line cards in the cabinet.

Distribution of households by loop length

Responses to this question will be provided later.

Factors affecting the cost of cable or installation

- Increased costs associated with the placing of cable in dense urban areas is reflected in the Hatfield Model by the significantly higher cost of structure assumed as default values in the highest density zone. The following are the default values used for underground placement of copper and fiber feeder cable:

Underground Conduit Default Values per Foot of Copper Feeder Cable							
CBG Density (Lines/sq. mi.)	Man-holes (ea.)	Manhole Spacing (ft.)	Manhole Cost/ft.	Conduit Installation per Trench-Foot	Under-ground Structure Cost per Trench-Ft.*	PVC Conduit Material per Duct-Foot	Total Conduit Cost per Sheath-foot
0 - 5	$3,000	800	$3.75	$25.00	$8.33	$1.00	$9.33
5 - 200	$3,000	800	$3.75	$25.00	$8.33	$1.00	$9.33
200 - 650	$3,000	800	$3.75	$25.00	$8.33	$1.00	$9.33
650 - 850	$3,000	800	$3.75	$25.00	$8.33	$1.00	$9.33
850 - 2550	$3,000	600	$5.00	$45.00	$15.00	$1.00	$16.00
> 2550	$3,000	400	$7.50	$75.00	$25.00	$1.00	$26.00

*Assumes 3-way sharing of conduit with other utilities.

Underground Conduit Default Values per Foot of Fiber Feeder Cable							
CBG Density (Lines/sq. mi.)	Man-holes (ea.)	Manhole Spacing (ft.)	Equiv. Manhole Cost/ft.	Conduit Installation per Trench-Foot	Under-ground Structure Cost per Trench-Ft.*	PVC Conduit Material per Duct-Foot	Total Conduit Cost per Sheath-Foot
0 - 5	$3,000	2,000	$1.50	$25.00	$8.83	$1.00	$9.83
5 - 200	$3,000	2,000	$1.50	$25.00	$8.83	$1.00	$9.83
200 - 650	$3,000	2,000	$1.50	$25.00	$8.83	$1.00	$9.83
650 - 850	$3,000	2,000	$1.50	$25.00	$8.83	$1.00	$9.83
850 - 2550	$3,000	2,000	$1.50	$45.00	$15.50	$1.00	$16.50
> 2550	$3,000	2,000	$1.50	$70.00	$23.83	$1.00	$24.83

*Assumes 3-way sharing of conduit with other utilities.

- In addition, significantly more cable is placed in underground structure in the highest density zones. Because placement in underground structure is more expensive than aerial or buried placement, this also has the effect within the Hatfield model of elevating the cost of cable placement in dense urban areas.

Question 5 Part E

Digital carrier: the number of lines served by carrier; the investment in carrier and investment in carrier as a percent of circuit investment.

See Attachment 5acdei - PTCA, SWTX, and GTAR.

Question 5 Part F

Depreciation: the model depreciation rate and expected life by type of plant, and ARMIS 43-03 plant in service row.

	HM 2.2.1	HM 2.2.2		ARMIS
Plant Category	**Service Life**	**Service Life**	**Depr. Rate**	**43-03 Accts.**
Loop distribution	24	20.2	5.0%	2421, 2422, 2423 metallic
Loop feeder	28	20.1	5.0%	2421, 2422, 2423 combo metallic & fiber
Loop concentrator	10	10.4	9.6%	2232
End office switching	20	14.3	7.0%	2212
Wire center		37	2.7%	2121
Tandem switching	15	14.3	7.0%	2212
OS investment	13	8	12.5%	2220
Transport facilities	17	19	5.3%	2421, 2422, 2423, 2426 fiber
STP	14	14.3	7.0%	2212
SCP	14	14.3	7.0%	2212
Links	14	19	5.3%	2421, 2422, 2423, 2426 fiber
Public telephones	9	9.2	10.9%	2351
General support	18	7.1	14.1%	2112, 2115, 2116, 2122, 2123, 2124

Question 5 Part G

Expenses: direct network expenses; indirect expenses; and common and overhead expenses. Please explain how the model allocates expenses among these various expense categories.

Because the Hatfield model applies TELRIC/TSLRIC principles in estimating costs, any costs that are attributable to a particular network element or service, regardless of whether traditional USOA conventions would have called such a cost "direct," "indirect," "common" or "overhead," is included in the element or service's economic cost. In general, direct network expenses are allocated to the network element that these expenses support based on that element's investment. Indirect expenses are calculated based on the number of lines served by the LEC, and are distributed among network elements based on investment. Common and overhead expense (in traditional USOA parlance) are captured through a user-adjustable factor (default value of 10%) that is distributed equiproportionately across elements.

Question 5 Part H

Capital Costs: return on capital; and taxes. Please explain how the percentage return on capital was calculated; and how tax gross-ups were determined.

Cost of Capital

The cost of capital used in the Hatfield Model is a weighted average cost of capital. It is based on the relative quantity of debt in the LEC's capital structure and the cost of that debt, and the relative quantity of equity in the LEC's capital structure and the cost of that equity. These parameters are all user-adjustable inputs to the Hatfield model.

In the submission of HM 2.2.1 that was provided to the Commission in an ex parte filing on July 5, 1996, the default capital structure was assumed to be 45% debt and 55% equity with a cost of debt of 7.7% and a cost of equity of 11.9%. Weighting these costs of debt and equity by their assumed relative portions in the LEC's capital structure yields an overall weighted average cost of capital of 10.01% (= .45*7.7% + .55*11.9%).

Tax Gross-Ups

The above cost of capital is an after-tax cost of capital. Thus, the LEC's actual return on capital must be grossed-up to a level sufficient to both pay the LEC's Federal Income Tax (FIT) and to leave the LEC with net earnings equal to its after-tax cost of capital. Because interest payments on debt are a tax-deductible expense, only the return on average net investment (total plant less accumulated depreciation) associated with payments to equity requires a tax gross-up.

This FIT gross-up amount is calculated by dividing the equity portion of the FIT on the total return on investment by the gross-up factor. The tax gross-up factor is 1 - the tax rate. This calculations produces the correct level of return to provide a company with sufficient after tax income to pay its shareholders a market return on their investments.

The formula for calculating the FIT gross-up can be expressed as follows:

Grossed-Up Cost of Capital = (EquityP * Return * **FITR**) / (1 - **FITR**)

where:

EquityP = the equity percentage of LEC's capital structure (default assumption is 55%)
Return = Cost of Capital * Average Net Investment
FITR = the FIT tax rate (default assumption is 40%)

Question 5 Part I

Support: the aggregate support at $20, $30 and $40 support levels and the number of households by cost category, where cost categories are ranges of cost per month such as greater than and equal to $5 and less than $10.

See Attachment 5i - PTCA, SWTX, and GTAR.

Question 6

For the GTAR, PTCA, and SWTX study areas, please provide the results of a sensitivity analysis using the following assumptions: the distribution fill factors are 0.25, 0.35, 0.45, 0.55, 0.65, 0.75 for density zones 1 to 6 respectively; the fill factors for the AFC electronics and the SLC electronics are 80%; cost per access line for SLC electronics and AFC electronics is $500 and $550 respectively; and the discount for SLC electronics and AFC electronics is 25% and 10% respectively.

Responses to this question will be provided later.

Question 7

Is it feasible and/or advisable to integrate the grid cell structure used in the Cost Proxy Model proposed by Pacific Telesis into the HM for identifying terrain and population in areas where population density is low?

The Hatfield model is based on U.S. Census Bureau Census Block Groups (CBGs) primarily because these are the smallest manageable unit of geography for which population data are readily available. Theoretically, it would be possible to incorporate a "grid" approach similar to that used in the CPM into the Hatfield model -- if the number of residences, number of businesses and the V&H coordinates for each grid cell were available. MCI, AT&T and Hatfield do not currently have information on these parameters of the CPM grids.

A planned future enhancement to the Hatfield model is to locate residences and businesses according to Postal Service Zip+4 codes. Work has begun on this project, and we anticipate that the results will be incorporated into the Hatfield model within two months. Zip+4 codes are considerably smaller than CBGs, and operating the model at this level should overcome any concerns about CBGs being "too large" in sparsely populated areas. This approach may have the additional advantage of readily supporting administration of universal service funding. Because telephone company billing records generally include Zip+4 codes, use of these codes in developing cost information may enable easy identification of residence customers who require universal service support.

Question 8
For the GTAR, PTCA, and SWTX study areas, provide the cost of the pedestal, drop wire and network interface device by density zone and housing type.

While the default values for these inputs are as follows, all such parameters in the HM 2.2.2 are user-adjustable.

Pedestal (terminal+splice)	$35 installed
Drop wire	$40 installed
NID	$30 installed

Attachment 5b - PTCA

ACCOUNT COMPARISON: ARMIS vs. HM 2.2.2

PACIFIC BELL - CALIFORNIA

USOA	$(OOO) DESCRIPTION	43-03 ARMIS COST	HM UNE COST	UNIV SVC RETAIL OPS COST	HM UNE + US RETAIL COST	RATIO: HM UNE+US / ARMIS
	PLANT SPECIFIC EXPENSES					
6112	MOTOR VEHICLES	5,592				
6113	AIRCRAFT	138				
6114	SPECIAL PURPOSE VEHICLES					
6115	GARAGE WORK EQUIPMENT	773				
6116	OTHER WORK EQUIPMENT	2,531				
6110	NETWORK SUPPORT	9,034	4,502		4,502	50%
6121	TOTAL LAND & BUILDINGS	169,880	40,922		40,922	
6122	FURNITURE	6,840	4,002		4,002	
6123	OFFICE EQUIPMENT	34,441	20,149		20,149	
6124	GENERAL PURPOSE COMPUTERS	147,685	86,402		86,402	
6120	TOTAL LAND & SUPPORT ASSETS	358,846	151,475		151,475	42%
	TOTAL NETWORK & GENERAL SUPPORT	367,880	155,977		155,977	42%
6211	ANALOG ELECT SWITCH	66,764				
6212	DIGITAL ELECTRONIC SWITCHING	235,012	46,520		46,520	
6215	ELECTRO MECHANICAL	76				
6210	CENTRAL OFFICE SWITCHING	301,852	46,520		46,520	15%
6220	OPERATOR SYSTEMS	17,912	3,155		3,155	
6231	RADIO SYSTEMS					
6232	CIRCUIT EQUIPMENT	105,025	27,065		27,065	
6230	TRANSMISSION	107,690	27,065		27,065	25%
6311	STATION APPARATUS	700				
6341	LARGE PRIVATE BRANCH EXCHANGE					
6351	PUBLIC TEL TERMINAL EQUIPMENT	21,126	20,496		20,496	
6362	OTHER TERMINAL EQUIPMENT	149,494	28,665		28,665	
6310	TOTAL INFORMATION ORIG/TERM	171,320	49,161		49,161	29%
6411	POLES	2,645	473		473	
6421	AERIAL CABLE	218,978	149,118		149,118	
6422	UNDERGROUND CABLE	115,384	15,611		15,611	
6423	BURIED CABLE	127,860	68,074		68,074	
6424	SUBMARINE CABLE					
6425	DEEP SEA CABLE					
6426	INTRABUILDING NETWORK CABLE					
6431	AERIAL WIRE					
6441	CONDUIT SYSTEMS	9,676	7,732		7,732	
6410	TOTAL CABLE & WIRE FACILITIES	476,418	241,006		241,006	51%
	PLANT NONSPECIFIC OPERATIONS					
6511	TPHFU					
6512	PROVISIONING EXPENSES	(3)				

ACCOUNT COMPARISON: ARMIS vs. HM 2.2.2

6531	POWER EXPENSES	47,291	31,022		31,022	
6532	NETWORK ADMINISTRATION	44,746	29,353		29,353	
6533	TESTING	185,737	121,841		121,841	
6534	PLANT OPERATIONS ADMINISTRATION	251,238	164,809		164,809	
6535	ENGINEERING	182,716	119,860		119,860	
6530	TOTAL NETWORK OPERATIONS EXPENSES	711,728	466,885		466,885	66%
6540	ACCESS EXPENSE	95,531				
6561	DEPRECIATION TPIS	1,700,796	828,990		828,990	
6562	DEPRECIATION TPHFU					
6563	AMORTIZATION - TANGIBLE					
6564	AMORTIZATION - INTANGIBLE					
6565	AMORTIZATION - OTHER					
	CUSTOMER OPERATIONS					
6611	PRODUCT MANAGEMENT	124,796				
6612	SALES	257,526				
6613	PRODUCT ADVERTISING	63,326				
6610	TOTAL MARKETING EXPENSES	445,648				
6621	CALL COMPLETION SERVICE	78,503				
6622	NUMBER SERVICES	207,747		33,189	33,189	
6623	CUSTOMER SERVICES	686,248		269,938	269,938	
6620	TOTAL SERVICES EXPENSES	972,498		303,128	303,128	
	TOTAL CUSTOMER OPERATIONS	1,418,146		303,128	303,128	21%
	CORPORATE OPERATIONS					
6711	EXECUTIVE	23,689				
6712	PLANNING	19,373				
6710	TOTAL EXECUTIVE & PLANNING	43,062				
6721	ACCOUNTING & FINANCE	63,835				
6722	EXTERNAL RELATIONS	56,555				
6723	HUMAN RESOURCES	89,839				
6724	INFORMATION MANAGEMENT	477,412				
6725	LEGAL	32,672				
6726	PROCUREMENT	13,361				
6727	RESEARCH & DEVELOPMENT	3,516				
6728	OTHER GENERAL & ADMINISTRATIVE	550,206				
6720	TOTAL GENERAL & ADMINISTRATIVE	1,287,396				
	TOTAL CORPORATE OPERATIONS	1,330,458	299,991	30,313	330,303	25%
	TOTAL OPERATING EXPENSES	6,699,728	2,118,750	333,440	2,452,190	37%
7240	OPERATING OTHER TAXES	179,898	154,008		154,008	86%
	TOTAL EXPENSES & OPERATING TAXES	**6,879,626**	**2,272,758**	**333,440**	**2,606,198**	**38%**
	TELECOMMUNICATION PLT IN SERVICE					
2111	LAND	200,550	44,411		44,411	

Attachment 5b - PTCA

ACCOUNT COMPARISON: ARMIS vs. HM 2.2.2

2112	MOTOR VEHICLES	290,051			
2113	AIRCRAFT				
2114	SPECIAL PURPOSE VEHICLES	1,578			
2115	GARAGE WORK EQUIPMENT	17,056			
2116	OTHER WORK EQUIPMENT	185,064			
2121	BUILDINGS	2,284,309	505,855	505,855	
2122	FURNITURE	112,749	65,963	65,963	
2123	OFFICE EQUIPMENT	124,230	72,679	72,679	
2124	GENERAL PURPOSE COMPUTERS	1,620,611	948,122	948,122	
2110	TOTAL LAND & SUPPORT ASSETS	4,836,198	1,637,031	1,637,031	34%
2211	ANALOG ELECT SWITCH	1,203,481			
2212	DIGITAL ELECTRONIC SWITCHING	3,694,446	1,729,355	1,729,355	
2215	ELCTROMECHANICAL SWITCHING	258			
2210	CENTRAL OFFICE SWITCHING	4,898,185	1,729,355	1,729,355	35%
2220	OPERATOR SYSTEMS	115,520	25,071	25,071	
2231	RADIO				
2232	CIRCUIT EQUIPMENT	4,032,428	1,541,359	1,541,359	
2230	TRANSMISSION	4,142,541	1,541,359	1,541,359	37%
2311	STATION APPARATUS				
2321	CUSTOMER PREMISES WIRING				
2341	LARGE PRIVATE BRANCH EXCHANGE	3,335			
2351	PUBLIC TEL TERMINAL EQUIPMENT	171,727	166,605	166,605	
2362	OTHER TERMINAL EQUIPMENT	256,724	621,073	621,073	
2310	TOTAL INFORMATION ORIG/TERM	431,786	787,678	787,678	182%
2411	POLES	560,141	174,119	174,119	
2421	AERIAL CABLE	2,221,984	1,676,433	1,676,433	
2422	UNDERGROUND CABLE	3,611,170	712,592	712,592	
2423	BURIED CABLE	1,888,195	1,405,238	1,405,238	
2424	SUBMARINE CABLE				
2425	DEEP SEA CABLE				
2426	INTRABUILDING NETWORK CABLE				
2431	AERIAL WIRE				
2441	CONDUIT SYSTEMS	2,177,826	1,774,420	1,774,420	
2410	TOTAL CABLE & WIRE FACILITIES	10,775,902	5,742,801	5,742,801	53%
	TPIS (BEFORE AMORTIZABLE ASSETS)	**25,455,945**	**11,463,296**	**11,463,296**	**45%**